Joint Planning and Development Office

Next Generation Air Transportation System

Integrated Work Plan:

A Functional Outline

Version 1.0

September 30, 2008

Preface

The future of our nation's ability to move people and goods in a safe, secure, efficient and environmentally-responsible manner depends upon the successful implementation of the Next Generation Air Transportation System (NextGen). The Joint Planning and Development Office (JPDO) was established by the U.S. Congress to guide and support the creation of NextGen. To guide and facilitate the most effective execution of these efforts, the JPDO is releasing Version 1.0 of the NextGen Integrated Work Plan (IWP).

The IWP is part of a comprehensive suite of information that represents the Integrated Plan for NextGen. The Concept of Operations (ConOps) and Enterprise Architecture (EA), previously released by the JPDO, provide a common vision for how NextGen will operate in the 2025 timeframe and beyond. NextGen is a complex undertaking that requires a comprehensive plan to facilitate

The Integrated Work Plan (IWP) provides a tool to support the collaborative planning and deliberation needed among partners and stakeholders to prioritize needs, establish commitments, coordinate efforts, and focus resources on the work needed to achieve the Next Generation Air Transportation System (NextGen). The IWP provides comprehensive information about the elemental operational improvements, enablers, development and research milestones, as well as policies needed to make NextGen a reality. These IWP elements define the overall NextGen plan. This release of the IWP is intended to facilitate coordination with government and industry partners as they implement NextGen.

It is important to note that the IWP is an unconstrained plan and does not seek to define prescriptive implementation activities, nor does it address priorities of activities at this time. It proposes a path to realize the IWP elements but not the specific program steps, resources or implementation elements such as facility rollout, training, or decommissioning. The detailed planning for each IWP element is the responsibility of the NextGen Partner that has accepted the element as part of their overall mission.

IWP Version 1.0 includes a broad range of planning information with many attributes and dependencies that are difficult to digest in a written document. To fully comprehend and use the power of the information within the IWP, the Joint Planning Environment (JPE) is available at www.jpdo.gov. The JPE tool provides the user with full access to the IWP information and supports interactive analysis for decision making.

To develop IWP Version 1.0, the JPDO engaged hundreds of aviation professionals, engineers, subject matter experts, analysts and planners across the Federal government, industry, and the public for almost three years. The content has undergone a thorough review and commenting process by the public as well as government and industry partners. Over 3,000 comments were received from the review of Versions 0.1 and 0.2 and are now incorporated, as appropriate, into Version 1.0. The status of comments submitted by stakeholders can also be found at www.jpdo.gov.

JPDO will issue annual updates to the IWP that reflect new understanding from research or development efforts, changing economic or technical conditions, as well as alignment with the programmatic efforts of NextGen Partners. It will also need alignment with an avionics road map, currently under development, that will identify the expected aircraft capability and equipage strategies envisioned for NextGen. The avionics roadmap will be distributed for stakeholder comment in FY09 and subsequently incorporated into the IWP.

Executive Summary

PURPOSE

The Integrated Work Plan (IWP) provides a tool to support the collaborative planning and deliberation needed among partners and stakeholders to prioritize needs, establish commitments, coordinate efforts, and focus resources on the work needed to achieve the Next Generation Air Transportation System (NextGen). The IWP provides comprehensive information about the elemental operational improvements, enablers, development and research milestones, as well as policies needed to make NextGen a reality. These IWP elements define the overall NextGen plan. This release of the IWP is intended to facilitate coordination with government and industry partners as they implement NextGen.

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OVERVIEW

The future of our nation's ability to move people and goods in a safe, secure, efficient, and environmentally responsible manner depends upon the successful implementation of NextGen. NextGen represents a comprehensive transformation and evolution of our nation's air transportation infrastructure, as well as how the infrastructure is developed, operated and maintained. With the 2003 enactment of the Vision 100 – Century of Aviation Reauthorization Act, a congressional mandate was issued to create the Joint Planning and Development Office (JPDO) to guide and support the creation of NextGen. As authorized under "Vision 100", the JPDO is charged with creating and carrying out an Integrated Plan for NextGen that shall include: "the national vision statement", "a description of demand and performance characteristics" required, "a multiagency research and development roadmap" necessary to overcome the most significant technical obstacles, "a description of the NextGen operational concepts", and a "timeline" to develop and deploy the system. To describe an overall path towards the 2025 characteristics, the IWP must be aligned with the near-term and mid-term plans of each Federal Partner. Therefore, this release of the IWP is intended to facilitate coordination across the NextGen Partners.

The IWP is part of a comprehensive suite of information that represents the Integrated Plan for NextGen. As shown in Figure ES-1, JPDO initially developed the NextGen Concept of Operations (ConOps) and Enterprise Architecture (EA). These core documents provide a common vision for how NextGen will operate in the 2025 timeframe and beyond, as well as a foundation for the NextGen Business Case.

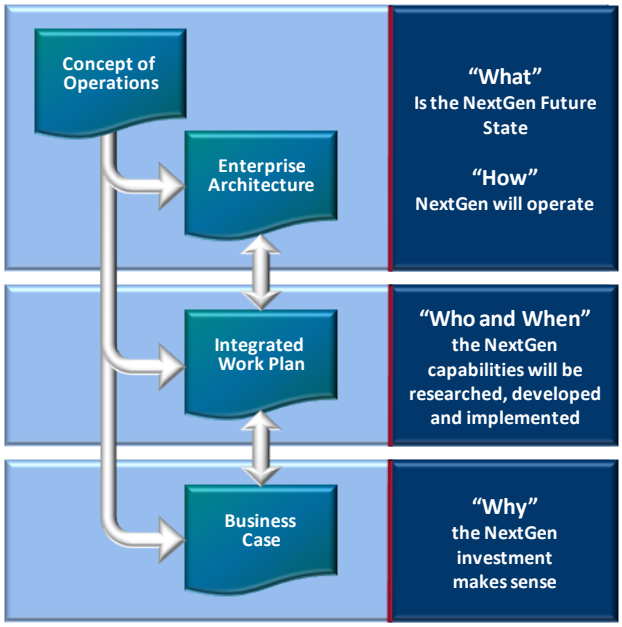

Figure ES-1 JPDO Integrated Plan Documents

NextGen requires an unprecedented level of sustained, coordinated, and integrated effort across the public and private sectors. To create and realize the benefits of this air transportation system for the 21st century, NextGen requires new and significant:

- **Automation:** Integrated information systems are needed that provide advanced trajectory, separation, capacity, flow contingency and security management functions.
- **Infrastructure:** Advanced technologies are needed that provide integrated communication, navigation, surveillance, and security infrastructure services.
- **Processes:** New automation and infrastructure requires new and revised responsibilities and integrated processes to provide increased capacities and efficiencies.
- **Collaboration:** Industry and government need to work together in new ways to define, fund, develop, implement, govern, and operate NextGen technologies, processes, and policies.
- **Integrated Operations:** NextGen operational processes and technologies require the integration of safety, security, and environmental requirements as core components.
- **Information Sharing:** Integrated operations require the broad sharing of information across many organizations and systems in an open, yet secure, manner.
- **Knowledge Development:** NextGen can benefit from formal and informal networks to enhance the creation of new knowledge, resulting in more innovative problem solving.

THE JPDO NEXTGEN ANNUAL PLANNING PROCESS

As mandated by the U.S. Congress, the JPDO leads an annual process to analyze, define, coordinate, and synchronize NextGen research, development, and implementation. Critical to this annual process is the interaction with Partners and stakeholders to receive and integrate their concerns and issues as well as incorporating their plans and progress. As shown in Figure ES-2, this annual planning process starts with the set of integrated NextGen planning information including the IWP.

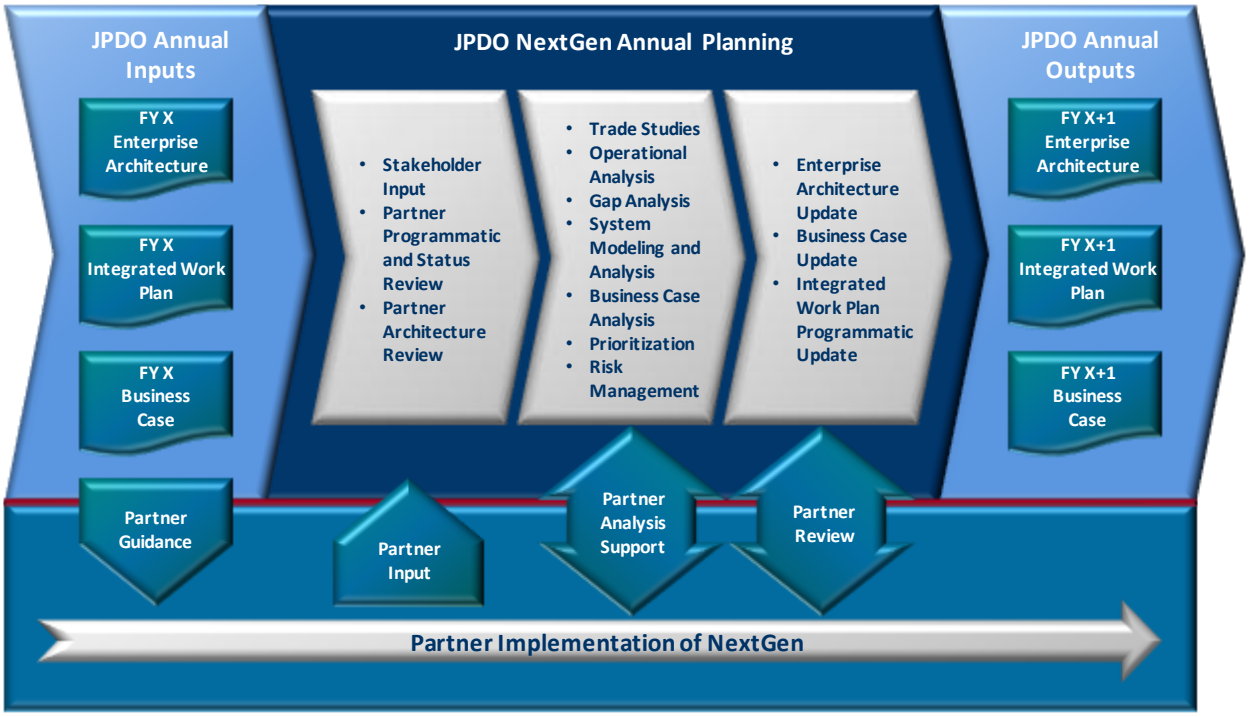

Figure ES-2 JPDO Annual Planning Process

The JPDO Partners include the aviation industry and users, aviation operators, state and local governments, as well as the Federal Partners of the Federal Aviation Administration (FAA), the Departments of Commerce (DOC), Defense (DOD), Homeland Security (DHS), and Transportation (DOT), the National Aeronautics and Space Administration (NASA), and the White House Office of Science and Technology Policy.

IWP STRUCTURE AND FUNCTIONAL AREAS

To describe the transformation to NextGen, the IWP is categorized into nine functional areas derived from the NextGen EA and ConOps. These nine areas are highly interdependent and integrated within and among each other. For brevity, the IWP does not fully describe the operational concepts and functions of each area. The reader is invited to review the NextGen ConOps and EA found at www.jpdo.gov for additional information. The IWP functional areas are:

- Trajectory and Performance-Based Operations and Support
- Airport Operations and Support
- Safety Management
- Layered Adaptive Security
- Environmental Management Framework
- Weather Information Services
- Net-Centric Infrastructure
- Positioning, Navigation and Timing Services
- Surveillance Services

The transformations needed within each functional area are described using a set of integrated planning data elements. There are five basic planning data element types within the IWP.

- **Operational Improvement (OI):** OIs describe the operational transformational changes needed to achieve the operational concepts defined in the ConOps. An OI describes a specific stage in the transformation of operations and the performance improvements expected at that point in time.
- **Enabler:** An Enabler describes the initial realization of a specific NextGen functional component needed to support one or more OIs or other Enablers. Enablers describe material components such as communication, navigation, and surveillance systems, as well as non-material components such as procedures, algorithms, and standards.
- **Policy Issue:** Many of the IWP OIs and Enablers require policy changes to support their realization, particularly related to interoperability, standardization, and governance. Policy Issues are intended to encourage decision-maker consideration of viable solution options, ranging from further analysis and open discussion for less mature issues to specific policy recommendations for more mature issues.
- **Development Activity:** Development activities describe the results needed from ongoing development or demonstration programs to support other NextGen planning efforts.
- **Research Activity:** Research activities describe basic or applied research programs and the results needed to support other NextGen planning elements.

These unique and non-overlapping planning elements define the core set of building blocks needed to achieve the NextGen vision. The current attributes of each IWP planning element include a target initial operational or availability date, the Suggested Office of Primary Responsibility (SOPR), the Suggested Office of Collaborative Responsibility (SOCR), and the dependencies of the element with other elements in the IWP. Through the definition of dates, dependencies, and organizations, the IWP is structured to define the proposed time-based, functional and organizational relationships needed to achieve the NextGen vision.

The JPDO will work closely with each of its partners to understand their needs and capabilities, and to facilitate alignment between NextGen Partner plans and the IWP. As alignment and subsequent commitments are received from NextGen Partners and these commitments are reflected in their respective plans, the suggested responsibilities will change to a designated Office of Primary Responsibility (OPR) or Office of Collateral Responsibility (OCR). As NextGen matures, the IWP along with the EA will be used to understand the collective NextGen progress, and identify and resolve cross-agency integration issues. Ultimately, as the NextGen vision is realized, the IWP will become a high-level compilation of these agency plans and the plans of other partners. Likewise, the EA maintained by JPDO will become a federation of the relevant architectures maintained by each implementing agency. Future versions of the IWP will reflect commitment status including the level of commitment and planning maturity ranging from conceptual dates to active planning targets to full partner commitments. Planning and conceptual dates should be viewed as approximate, reflecting a range of possibilities that are dependent on the results of enabling activities such as research and technical maturation.

The IWP planning elements are highly integrated with many-to-many relationships. Figure ES-3 shows an example of potential relationships between IWP elements. For example, a Policy Issue can support one or more elements of any type. Research Activities can support Enablers or Development Activities that may in turn support multiple Enablers or OIs. Enablers may support one or more OIs, or support other Enablers that in turn support OIs. There are thousands of dependencies and relationships among the IWP planning elements. All of these relationships and dependencies eventually support one or more OIs. This complex but necessary relationship matrix is difficult to present in a written document. The reader is encouraged to access the interactive Joint Planning Environment (JPE) available at www. jpdo.gov to view and understand the full set of relationships and dependencies among the IWP planning elements.

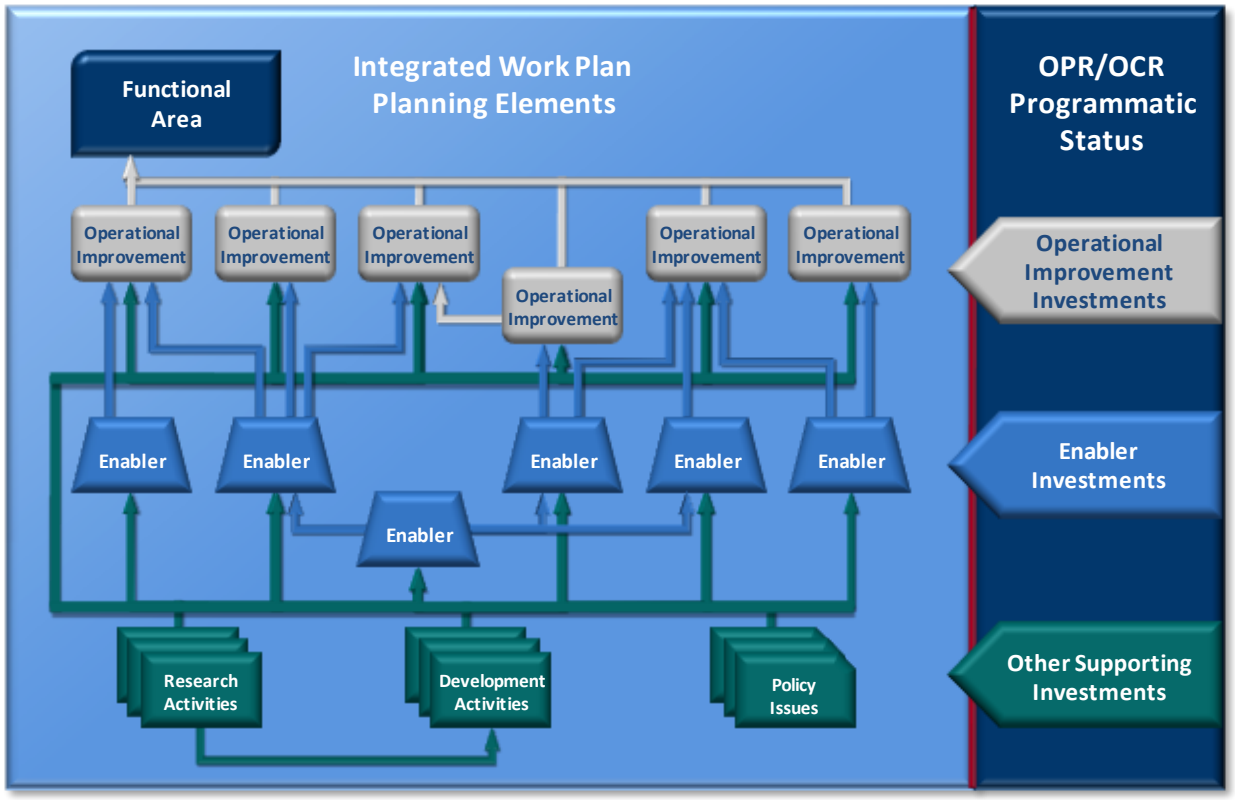

Figure ES-3 IWP Planning Elements

The following sections present a summary of each IWP functional area including highlights of the planning elements for each.

TRAJECTORY AND PERFORMANCE-BASED OPERATIONS AND SUPPORT

NextGen requires a fundamental shift to trajectory and performance-based operations with full situational awareness and integration of weather, safety, security, and environmental information. Trajectory-based operations (TBO) uses precise four-dimensional trajectories (4DT) that are actively managed to optimize an individual flight, as well as the overall operations of the National Airspace System (NAS). TBO requires the use of precise and timely surveillance, navigation, and weather information that is distributed and shared over a secure national integrated network. It requires new policies, processes, procedures, standards, and rules to guide TBO functions. TBO will also require the air navigation service provider (ANSP), the aircraft operator, the airport, and the aircraft to use new and advanced information systems to support active management of flights. Performance-based operations (PBO) incorporate an aircraft's performance capabilities into the management of flights and the air transportation system. NextGen will provide varying levels of service and operating flexibility, depending on the performance capability of the aircraft. Specific operations and airspace will be allocated to aircraft that meet required communications, navigation, and surveillance (CNS) performance thresholds, enabling increased capacity.

Operational Improvements: To achieve the TBO and PBO concepts defined in the NextGen vision, many OIs must be executed across multiple organizational structures, types of airspace, phases of flight, aircraft types, operating conditions, and locations. OIs must be implemented to support the direct management of flights by the ANSP and the aircraft crew. In addition, OIs will address the support functions performed by the ANSP, the aircraft operator, and many other organizations. To describe this rich diversity, the IWP presents TBO and PBO OIs in the following functional groups:

- **Trajectory Management:** Trajectory Management OIs support the NextGen transformation to the integrated management of aircraft movement on the surface and during all phases of flight, using precise 4DTs in the most efficient, safe, secure, and environmentally responsible manner possible. Trajectory Management OIs describe the evolution from today's processes where controllers guide an aircraft crew along rigidly defined routes over inefficient and constrained voice communication systems using a multitude of loosely integrated information systems with imprecise position information. From this safe, yet inefficient and capacity-limited system, Trajectory Management OIs describe: the improvements in the surface, arrival/departure, and en route domains; the increasing levels of Decision Support Tools (DST) introduced for ANSP and aircraft support; the changing roles of humans and automation; and the eventual transformation to highly efficient and flexible operations using advanced and integrated DSTs, and CNS systems.
- **Separation Management:** To achieve the NextGen goals for improved capacity, the separation between aircraft in all airspace environments must be safely reduced and effectively managed for simple as well as complex operations. Separation Management OIs describe the evolution from today's processes where controllers manage aircraft separation using a static set of separation standards and position information from radar-based systems, to future operations where separation is managed with a wide range of standards using precise and timely aircraft position information. Using increasingly sophisticated DSTs and processes, aircraft separations are closely managed and tailored to the unique needs of an aircraft and airspace to achieve the safest minimum separation from hazards such as wake turbulence, terrain, severe weather, as well as other aircraft. As separation capabilities improve, the responsibility for separation is increasingly delegated from the ANSP to properly equipped aircraft to improve efficiency and flexibility.

- **Capacity Management:** The capacity of the national airspace must be actively managed to effectively balance the demands of users with the constraints and operating conditions in all locations. Capacity Management OIs describe the evolution from today's operational models where capacity is managed at a macro level using a limited set of inflexible rules, to a future state where capacity is dynamically adjusted on a micro level with a wide range of rules that safely support demands and constraints with full situational awareness. Starting with OIs that allow for the improved scheduling and access to special use and terminal airspace, Capacity Management is improved by increasing airspace flexibility and allocation of ANSP resources. Using increasingly sophisticated DSTs, the ANSP is able to adjust airspace configurations and resources to meet the unique needs and environmental conditions for specific locations. From the initial ability to adjust specific configurations, the Capacity Management OIs describe the ability to dynamically adjust airspace configurations and classifications in full collaboration with airports, capable aircraft, and aircraft operators. To provide increased capacity, OIs also define improvements such as flow corridors and advanced Special Use Airspace (SUA) management.
- **Flow Contingency Management:** In support of the active airspace management, there will always be a need to modify plans to accommodate special or changing conditions. To optimize the overall flow and capacity of the national airspace, the Flow Contingency Management OIs describe how today's mostly manual processes, using limited DSTs, evolve to highly integrated and collaborative processes, using automated DSTs with full situational awareness. Using increasing levels of collaboration and integration between ANSP, aircraft operators, and aircraft, flights are adjusted to accommodate changing conditions. Initially adjusted and rerouted during pre-flight planning, flight plans and trajectories will eventually be dynamically adjusted during flight, using integrated processes and digital communication between the flight deck and ANSP automation. Rather than traffic management initiatives (TMIs) that broadly apply to multiple flights, flight plans will be uniquely tailored to accommodate the needs of each user, yet balanced with the overall demands, capacities, and constraints of the national airspace.

Enablers: TBO and PBO require a comprehensive set of integrated Enablers that support the active management of aircraft. These Enablers include a suite of advanced and integrated ANSP DSTs that support the following functions:

- Surface Management
- Separation Management
- Capacity and Flow Contingency Management
- Aeronautical Information Management
- Virtual Tower
- Separation Management
- Trajectory Management
- Flight Planning
- Wake Management
- Oceanic Operations

TBO and PBO also require core infrastructure Enablers that provide CNS services as defined in their respective functional areas. In coordination with, and supported by, these core infrastructure Enablers, the NextGen ANSP DSTs will provide more flexible, robust, and efficient decision support for all phases of flight. They will provide enhanced functionality, broader integration, and full situational awareness using a secure net-centric infrastructure (NCI). TBO and PBO also require aircraft and aircraft operator investments that support distributed separation and trajectory management functions, as well as requirements for safety, security, and environmental management. Aircraft and aircraft operators will need a range of new or enhanced navigation, surveillance, communication and flight management avionics, as well as flight planning and management systems. These new or enhanced DSTs and avionics require coordinated and significant investments, representing one of the greatest challenges to the success of NextGen.

Research and Development Activities: Some of the TBO and PBO concepts require further research and development (R&D) to guide the overall NextGen effort. Some of the more challenging areas include:

- The integration of safety-critical digital data exchange of information, such as 4DT and flight clearances, into the operational processes and systems used for flight management and control
- Algorithms for dynamic, real-time trajectory management, incorporating conflict management, flow optimization, and incorporation of multiple user preferences
- The allocation of roles and responsibilities between automation and humans, as well as the allocation between controllers and flight crews
- Performance-based separation standards including wake turbulence factors
- Automation-assisted en route flight plan negotiation that accommodates changing conditions, such as weather and non-routine operations
- Aircraft equipment, such as displays and alerting systems, that support independent parallel or converging runway approach procedures
- An integrated simulation and modeling environment for the National Airspace System (NAS) that incorporates elements, such as airport demand and capacity, airspace allocation, aircraft performance capabilities, as well as environmental and safety performance management.

Policy Issues: TBO and PBO are significant changes to the current operations of the air transportation system. To guide and support the development of OIs and Enablers, many policies are needed that establish governance, require standards, define roles and responsibilities, and other areas. Some of the most difficult, yet important, policies needed in the near term will help to define the "rules of the road" for priority access to airspace and runways, the prioritization of flights in congested airspace, the standardization of equipment, the use of incentives or mandates for equipage, and the optimum configuration of ANSP facilities.

AIRPORT OPERATIONS AND SUPPORT

Innovative, capacity-enhancing solutions are needed to manage expected increases in aircraft operations, passenger flow, and cargo movements. NextGen seeks to increase the overall airport capacity through transformational concepts that enable the optimum and balanced utilization of runways, ramps/aprons, gates, and passenger terminal buildings. The Airport Operations and Support functional area addresses the complex factors affecting airport functions not directly involved with air traffic management (ATM).

Operational Improvements: NextGen advancements will seek to optimize the use of existing facilities and achieve the best possible throughput of aircraft, passengers, and cargo. For example, new airport facilities will be developed using NextGen design standards for runway layout. Airside operations will be improved through better coordination of ramp operations, use of advanced winter weather capabilities, such as coordinated deicing activities, and improved situational awareness of airport demand/capacity and operational issues. Landside operations will be improved, as applicable, to the needs of specific airports, through more efficient passenger flow management, expanded and coordinated intermodal ground transportation access, and off-airport passenger and baggage processing.

Enablers: Airside and landside operations must be balanced and enhanced through new technology, management procedures, and programs to optimize airport capacity. Surveillance of airport vehicles will be integrated into NextGen capabilities, so that pilots and ground crews have situational awareness of the airport surface during low-visibility conditions. This will improve safety and reduce runway incursions, a

critical need as more aircraft and ground vehicles operate on the airport surface. Because inclement weather can substantially impact surface operations, the resource systems used by airports, the ANSP and operators will integrate advanced weather information directly into decision-making. The airport environment will be able to better respond to lightning that can stop ramp operations, as well as proactively manage winter operations at airports for clearing snow from runways and deicing aircraft. NextGen Federal agencies will also partner with airports and industry to integrate remote check-in systems, intermodal transportation information systems, and advanced terminal designs to improve the overall passenger experience and reduce landside congestion.

Research and Development Activities: To guide the most effective use of airports, research is needed on travel patterns and modal choice in congested metropolitan areas, effective techniques for real-time gate management, optimized passenger movement patterns within terminals, and use of information systems for optimum airport resource management.

Policy Issues: Airports require effective collaboration of local, state, and Federal governments, as well as private organizations. Policies are needed that provide for the effective governance and collaboration among these varied interests as NextGen becomes a reality for the airport system. Near-term policy challenges include evaluating options for clarifying the federal role in airport preservation and capacity enhancements. Advocacy is envisioned as an important element to this, so that airport operators have the tools, resources, and federal support necessary to help local governments, businesses, users, and communities understand the importance of long-term airport sustainability and capacity enhancement.

WEATHER INFORMATION SERVICES

Weather plays a significant role in the majority of air transportation system delays. To reduce these delays, weather information needs to be assimilated into NextGen decision-making processes and integrated with NextGen decision support automation. The Weather Information Services functional area provides comprehensive four dimensional aviation weather information called the 4D Weather Cube, which in-turn provides a single authoritative source (SAS) of current and forecasted weather. This common weather picture is translated into potential impacts and integrated into the full suite of NextGen information management systems, allowing decision makers to have full situational awareness and the ability to minimize air transportation user disruptions due to adverse weather. This major paradigm change means weather is no longer just an end product to be viewed in a stand-alone display, requiring cognitive interpretation and impact assessment, and having little ability to significantly impact weather-related delays. Instead, weather information is designed to integrate with and support NextGen decision-oriented automation capabilities and human decision-making processes.

Operational Improvements: NextGen requires the development and execution of a weather operational structure that includes governance, standards, and collaboration of multiple organizations to detect, collect, process, forecast, and disseminate the weather information required by the 4D Weather Cube.

Enablers: The 4D Weather Cube needs: data standards and a governance structure to guide and support the development process and operations; a broad range of integrated ground, airborne, and satellite observation sources and platforms; enhanced models and processing of convective and winter storms, icing, turbulence, ceiling and visibility, volcanic ash, and space weather forecasts; and the development of supporting information systems. The methodologies and algorithms to assimilate weather information into the trajectory, separation, and capacity management systems are also critical Enablers.

Research and Development Activities: Enhanced probabilistic forecasting models/techniques, improved understanding on the optimum roles of human forecasters and automation, integration of weather forecasts and observations into the SAS, and the techniques to integrate and tailor weather information into ATM decision making and procedures requires additional R&D.

Policy Issues: Policies are needed to define the operational use of the SAS, including its integration into decision making, as well as determining responsibilities for managing separation from weather.

SAFETY MANAGEMENT

Safety Management seeks to ensure that the development and implementation of NextGen concepts achieves all of the NextGen goals while maintaining or improving safety. Achieving NextGen's goals requires a fundamental change in the way the air transportation community manages safety. Within the transition to NextGen, safety-enhancing practices and systems must be deployed as the product of an integral design-to-implementation safety management process. NextGen concepts must address current safety issues and the future safety risks of new operational concepts. Safety Management is a continuous improvement process that applies to all aspects of the aviation system throughout all phases of its lifecycle. The NextGen Safety Management approach is fully described by the products and policies produced by the JPDO Safety Working Group including the *National Aviation Safety Strategic Plan*, the *National Safety Management System Standard*, the *Aviation Safety Information Analysis and Sharing Concept of Operations*, and the *Safety Culture Improvement Resource Guide.*

Operational Improvements: The *National Aviation Safety Strategic Plan* provides specific goals, objectives, and strategies that support the transformation to NextGen and the achievement of its capacity-enhancement goals while improving safety. The Safety Management OIs were created in concert with the strategic plan's objectives, and are organized into the plan's goal areas of Safer Practices, Safer Systems, and Safer Worldwide.

- **Safer Practices** addresses the issues of consistency and completeness of safety management across government and industry, the development and enhancement of data sharing and information analysis capabilities, and the creation of safety as an inherent characteristic of NextGen. NextGen will require operational improvements that introduce new safety management systems standards, advanced information analysis and sharing approaches, and comprehensive safety culture concepts, along with enhanced methods for ensuring safety is an inherent characteristic of NextGen.
- **Safer Systems** addresses the issues of situational awareness for pilots, controllers, and other operators, and the integration of safety enhancing requirements and technologies into future systems. NextGen will require operational improvements that are supported by technology advancements for both airborne and ground-based systems.
- **Safer Worldwide** addresses the issues of consistency and compatibility of safety practices and systems across air transportation system boundaries. NextGen will require operational improvements that are brought about by increased international cooperation for aviation safety. It will also be important to improve safety across air transportation system boundaries, especially those dealing with dangerous goods.

Enablers: Safer Practices Enablers emphasize an integrated, systematic approach to safety risk management through implementation of formalized Safety Management Systems (SMS). These SMS incorporate safety data analysis processes, and the enhancement of safety certainty, operational procedures, and training supporting NextGen evolution. Safer Systems Enablers emphasize

implementation of safety-enhancing technologies, which will improve safety for human-centered interfaces and enhance the safety of airborne and ground-based systems. Safer Worldwide Enablers encourage coordinating the adoption of the safer practices and safer systems technologies, policies and procedures worldwide.

Research and Development Activities: The NextGen goals are to be achieved through a combination of new policies, procedures, operations, and advances in technology deployed to safely manage all air traffic operations. Safety-related research and development is implicit in the applied research and development associated with all the capabilities described in this plan. For safer practices, research on vulnerability discovery and the development of tools to support the NextGen Aviation Safety Information Analysis and Sharing (ASIAS) capability will be required. Research and development of methods for verification and validation of complex systems to support NextGen risk assessment and certification decisions are also critically important. Research to support human performance models that accurately capture human variability and human error in highly automated NextGen systems will lead to the development of risk-reducing interfaces, procedures, and training.

Policy Issues: Many of the Safety Management Enablers will require a strategic decision or resolution of policy issues. These policies are needed to help shape, guide, and support the realization of the NextGen vision. The policy section provides the initial set of policy issues supporting the Safety Management Enablers. Safety risks must be addressed within the context of NextGen planning, incorporating safety requirements into the NextGen operational improvements and their performance estimates. Addressing safety after developing NextGen concepts will impose capacity constraints on the future air transportation system, ensuring NextGen's goals are not achieved.

LAYERED ADAPTIVE SECURITY

Layered Adaptive Security seeks to predict, prevent, detect, identify, secure, and reduce the impact from threats to the entire air transportation system, without unduly limiting mobility or making unwarranted intrusions on the civil liberties of users, providers, and employees. From reservation to destination, security will be improved with adaptive technologies, policies, and procedures that are scaled and layered to the potential threats in each area.

Operational Improvements: NextGen seeks to improve the operational efficiency and effectiveness of securing people, airports, checked baggage, cargo, mail, airspace, and aircraft throughout the air transportation system based on a risk-managed framework. NextGen security OIs are highly dependent on the coordinated development and execution of national and international policies, standards, requirements, processes, and procedures by organizations throughout the public and private sectors. Coordinated and collaborative information sharing environments must be designed, implemented, and nurtured for successful aviation security.

Enablers: NextGen security OIs and Security Service Providers (SSP) require: advanced screening, detection, and containment technologies; integrated information processing and screening systems; advanced prediction, prevention, identification, containment, and response processes; and enterprise integrated risk management systems and approaches. A near-term and fundamental need is to establish National Security Performance Requirements and Standards for the screening of passengers, carry-on luggage, cargo, and mail. A transformational Supply Chain Entity Program will reduce security risks and improve overall efficiency. An integrated flight risk management system will improve airspace security by actively assessing risks and monitoring flights.

Research and Development Activities: NextGen security requires: the development of improved people and cargo screening technologies; improved technologies for the detection of hazardous materials; flight risk assessment algorithms; integrated risk management approaches for threat determination, impacts, and overall response; and increased protection and survivability of aircraft.

Policy Issues: Improved safety certification policies, tools, and processes are needed to allow the rapid, yet safe, adoption of new technologies in the most effective manner, balancing public and private sector resources. National policies and performance standards are needed for the physical screening of all passengers, airport meeters and greeters, baggage, cargo, and mail. Standardized requirements are needed to establish the National Certified Supply Chain and National Secure Supply Chain Entity programs.

ENVIRONMENTAL MANAGEMENT FRAMEWORK

The fuel use and environmental impacts on noise, air, water, and global climate from aviation operations will be significant constraints on the capacity and flexibility of NextGen unless they can be effectively managed and mitigated. The Environmental Management Framework (EMF) functional area seeks to balance the competing goals of minimizing environmental impacts, while maximizing the ability to meet increasing air transportation service demands. The NextGen vision is for an EMF strategy that is integrated into all NextGen operations. The EMF includes an Environmental Management System (EMS) framework that provides a systematic process to identify, manage, monitor, and mitigate the environmental demands of NextGen, while meeting the increased volumes and dynamic nature of the air transportation system.

Operational Improvements: NextGen OIs that benefit the environment are achieved through the development of informed policy objectives, implementation of environmental and energy favorable operations, use of environmentally improved engine and aircraft technologies, and the use of alternative aviation fuels. These improvements address the NextGen vision of preventing or reducing aviation's noise, air quality, fuel burn, airport water quality, and global climate impacts.

Enablers: NextGen is supported by Enablers that measure, monitor, manage, and mitigate environmental impacts including advanced EMS, environmentally favorable Optimized Profile Descents (OPD), alternative aviation fuels, and advanced science models, and prediction tools and techniques.

Research and Development Activities: Aggressive R&D programs are critical to develop new technology such as aircraft, engines, and alternative fuels, as well as new operational advances to reduce aviation's environmental impact. R&D is critical to advance our scientific understanding of complex aircraft noise and emissions atmospheric impacts, and to advance modeling capabilities to predict human health and welfare responses and interrelated environmental consequences. Together, these capabilities will enable implementing cost-beneficial environmental and energy improvements to keep pace with aviation growth.

Policy Issues: New environmental policies are required to support planning, design, and implementation of a NextGen EMS and to support national and international harmonization of aviation environmental management. This includes providing a high-level direction for addressing aviation environmental impacts of primary concern for NextGen, as well as establishing a national framework for developing and applying an EMS approach to achieving NextGen environmental goals.

NET-CENTRIC INFRASTRUCTURE

The NextGen vision requires users to have timely, accurate, secure, comprehensive, and appropriate levels of information. To efficiently and effectively share information among users and systems, NextGen will be enabled by a Net-Centric Infrastructure (NCI) and related services. Examples of NextGen information provided as a service over NCI include: flow and trajectory information; advisories and alerts; surveillance information; real-time NAS configuration; and weather reports and forecasts.

Enablers: NextGen operations will be transformed by advanced communication Enablers including integrated networks, open information sharing, and data communications among aircraft and ground systems. NextGen networks require integrated voice and data network infrastructure along with standardized information and infrastructure services. Standards for certification and interoperability are critical for successful network integration. To openly share information among NextGen Partners using standardized services and networks, standards are also needed that establish formats and protocols specific to the information being shared. Creating this broad range of standards requires a governance structure and organization supported by all NextGen Partners.

Improved communications will result from a transformation of special-purpose radio systems to integrated and flexible radio systems, allowing the widespread use of data communications in lieu of voice communications for domestic airspace air traffic control (ATC) operations. The backbone of this transformation will come from the implementation of ground voice networks and integrated voice/data networks to support pilot-controller exchanges. ANSPs will provide services to support data exchange of flight information, clearances and instructions, advisories, flight position, and trajectory information necessary for flight operations, as well as information to support situation awareness on security airspaces. SSPs will provide aviation security-related information services, such as airport risks, flight risks, and airspace wavers.

Research and Development Activities: NCI requires R&D activities to guide the implementation of Enablers. Future radio communication technologies and radio spectrum requirements and alternatives must be explored. Information sharing details and stakeholder roles and responsibilities must be explored, and future voice/data integration opportunities must be identified and evaluated.

Policy Issues: NCI requires the collaboration of many local, state, and Federal government, as well as private organizations. Policies and governance structures must be explored to guide development of information access controls, trust relationships, authenticating community of interest (COI) users, and mechanisms for protecting competitive information. Finally, policies and procedures must be developed for evaluating and certifying the trustworthiness, accuracy, and integrity of information from non-government sources.

POSITIONING, NAVIGATION AND TIMING SERVICES

NextGen will be more flexible, responsive, and unconstrained using satellite-based and ground-based systems that provide accurate and universal Positioning, Navigation, and Timing (PNT) Services. The PNT Services functional area enables aircraft and ground equipment to accurately and precisely determine current location, orientation, time, and path anywhere on the globe. With this information, aircraft can apply the corrections necessary to maintain a desired position and path. Accurate and precise PNT Services also enable improved surveillance capabilities, reduced separation standards, and the synchronization of operations. The decommissioning of current ground-based navigation systems, along with the improved operations from enhanced PNT Services, will result in significant cost savings.

Enablers: NextGen PNT Services require the evolution of the Global Positioning System (GPS), including satellites transmitting dual-frequency civil signals, enhanced position and timing accuracy, and more robust integrity monitoring. It also requires a comprehensive GPS back-up capability.

Research and Development Activities: A national PNT architecture and strategy is needed that includes a backup strategy to guide NextGen PNT Services. Approach and runway lighting systems also need improvements to reduce their costs and increase effectiveness.

Policy Issues: NextGen requires national and international policies that define the performance, responsibilities, and standards to be used across all PNT service providers.

SURVEILLANCE SERVICES

The NextGen Surveillance Services functional area provides the ability to detect, identify, and monitor the movements of cooperative and non-cooperative targets. Cooperative surveillance involves the self-reporting of aircraft or vehicle surveillance information to other aircraft, vehicles, and ground-based systems. It also involves the processing and dissemination of this information to NextGen users. Non-cooperative surveillance is needed for air sovereignty and security, as well as monitoring aircraft, ground vehicles, and other objects not equipped for cooperative surveillance. Surveillance Services represents a major investment of complex equipage, ground systems, communications, processes, and procedures that must be implemented, over time, by many NextGen Partners in a cooperative and synchronized manner.

Enablers: Legacy cooperative and non-cooperative radar systems must be maintained, replaced, and updated to support a net-centric integrated surveillance environment. An integrated surveillance strategy is needed to provide the governance and guidance for the development of an integrated national surveillance capability. The full implementation of automatic dependent surveillance-broadcast (ADS-B) is needed for complete cooperative surveillance.

Research and Development Activities: To provide an integrated national surveillance capability, research is needed to determine the required characteristics of national surveillance and associated communications needs. Research will include determining needed surveillance data sources and their accuracy, timeliness, and compatibility with different operator and facility functions.

Policy Issues: A key near-term Policy Issue is the completion of the National Integrated Surveillance Plan that will define security levels, criteria and approval processes to facilitate the sharing of complementary cooperative and non-cooperative surveillance data among public and private entities. With the adoption of ADS-B as the predominant cooperative surveillance technology, an interagency agreement is needed to determine how non-cooperative surveillance technologies may be used during cooperative system failures. It is also necessary to determine whether the non-cooperative architectures of the DHS and DOD will satisfy FAA ATM performance requirements during such failures.

PARTNER ALIGNMENT WITH INVESTMENTS, ACQUISITION, AND IMPLEMENTATION

The IWP is a functional plan that outlines the proposed building blocks towards achieving the NextGen vision. NextGen will be realized through the research, development, and implementation investments that are funded and managed by each NextGen Partner. The JPDO works with all NextGen Partners to align their investments towards achieving the overall NextGen vision. As previously shown in Figures ES-2 and ES-3, the JPDO will coordinate with each Federal Partner on at least an annual basis. This allows the JPDO to make any updates needed to reflect the status of program execution, highlight cross-agency issues, and work cooperatively with the respective organizations to resolve those issues.

IWP Version 1.0 conveys the current understanding of Partner efforts and presents the suggested alignment of NextGen planning elements with each Partner's mission areas. Through the review and commenting process for previous versions of the IWP, JPDO has received over 3,000 comments and engaged in detailed discussions with Federal Partners on current and planned NextGen efforts. For example, the IWP is currently aligned with the extended definitions of near-term OIs within the FAA NextGen Implementation Plan. Additional work is needed to continue this alignment for all near-term programs, as well as with mid-term and far-term plans. It should be noted that in the event of any conflicts between the IWP and specific Federal Partner plans, the near-term Partner plans take precedence. Any mid-term conflicts will require further collaborative coordination and alignment. It should also be noted that Partner plans and efforts have been incorporated into Version 1.0 and that the appropriate adjustments have been made to the overall IWP planning elements.

Many of the OI and Enabler planning elements within the IWP require basic or applied research and the development of research concepts into full implementation readiness. To help define the near-term R&D activities needed to fully support NextGen, the JPDO released the *NextGen R&D Plan for FY2009-FY2013* in August 2007. This initial plan was a collaborative effort of the JPDO and Federal Partners, and aligns with the 2007 *National Aviation Research Plan* issued by the FAA in and the 2006 *National Aeronautics Research and Development Policy* and *2007 National Plan for Aeronautics Research and Development including Related Infrastructure* issued by the National Science and Technology Council. The results from this initial plan, as well as updates to R&D needs, have been incorporated into the IWP.

NEXT STEPS

JPDO, in collaboration with the NextGen Partners, has developed IWP Version 1.0 as the initial outline of steps needed to achieve the NextGen vision. This initial plan requires ongoing refinement and updates to reflect:

- Results and guidance from modeling, simulation, and analysis
- Results and guidance from research, demonstration, and development efforts
- Changing needs and priorities for the national air transportation system
- Plans and commitments from NextGen Partners.

As previously shown in Figure ES-2, JPDO will work with its partners to develop a formal alignment and commitment process for IWP planning elements. The IWP will be used as a tool to facilitate discussion with NextGen Partners to establish commitments, coordinate efforts, and prioritize resources, with a goal of maximizing benefits. As NextGen matures, the JPDO will work with Partners to analyze, review and modify the planning elements of the IWP. Thus, the IWP will help identify cross-agency integration issues. As a collective view of NextGen elements and status, the IWP will provide stakeholders with a comprehensive view of NextGen progress.

The IWP will also need alignment with an avionics road map, currently under development, that will identify the expected aircraft capability and equipage strategies envisioned for NextGen. Additionally, future versions of the IWP will more fully describe priorities, benefits, risks, costs, technology maturity, and more completely reflect the NextGen-related activities of all NextGen Partners.